

The BIOMAN Journal



Non-Stop Learning at BIOMAN 2014

BIOMAN 2014 at Salt Lake Community College from July 14 to 17 offered community college and high school educators a unique opportunity. They learned about the latest equipment and processes for bioproduct development, production, and analysis from industry and education leaders, and how to teach biomanufacturing

topics using techniques and materials developed by the leaders of the Northeast Biomanufacturing Center & Collaborative (NBC2).

The blend of plenary addresses, interactive panel discussions, hands-on laboratory sessions, and tours of local industry gave BIOMAN participants numerous formal and informal learning opportunities throughout the four-day, biomanufacturing education conference.



Participants at BIOMAN 2014 gathered for a group photo at Salt Lake Community College's Jordan campus.

During the four-day meeting, the educators shared personal experiences and helped each other prepare to launch programs, courses, and modules that incorporate what they learned at BIOMAN. Conversations carried over to group meals and bus rides and by the end of the conference, participants had become colleagues and part of NBC2's national network of educators and industry professionals that promote, create, and sustain a skilled, qualified biomanufacturing workforce.

Innovative Faculty at Salt Lake Community College Host BIOMAN

BIOMAN 2014 was held at the Jordan campus of Salt Lake Community College (SLCC), where state-of-the-art biotechnology laboratories made it possible for 50 educators to receive hands-on laboratory instruction.

As she welcomed the BIOMAN participants to the four-day program, SLCC President Denece G. Huftalin praised Vivian Ngan-Winward, director of SLCC's biomanufacturing program, and Craig Caldwell, chair of SLCC's Biotechnology Department and interim dean of SLCC's School of Science, Mathematics and Engineering, for their creativity in the classroom and hard work.

The two SLCC faculty members who hosted BIOMAN have developed programs to attract students, and obtained grants and other external funds to acquire and maintain the college's excellent biotech education facilities.

"I'm very proud of InnovaBIO® and STUDENTfacturED®," Huftalin said, referring to the innovative programs that SLCC faculty developed with National Science Foundation (NSF) Advanced Technological Education (ATE) grants to give students hands-on, biotech industry-relevant experiences.

InnovaBIO® is a contract research organization that provides about 70 students each year with experience working on actual, commercial research projects. STUDENTfacturED® is a student-run company that teaches students to follow the production and quality control systems of a regulated industry environment to create and to market two products that are sold to college and high school teaching laboratories.

"The location for BIOMAN 2014 was spectacular. The integration on the Jordan campus, of high school, community college, and university education with authentic biotech work experiences is a wonderful model to behold," said Sonia Wallman, executive director and principal investigator of the Northeast Biomanufacturing Center & Collaborative (NBC2). NBC2 sponsors BIOMAN with NSF ATE support.

"We thank the many people at SLCC who made BIOMAN 2014 a great success," Wallman said.



*Sonia Wallman
NBC2 Executive Director and
Principal Investigator
Montgomery County Community College
Blue Bell, Pennsylvania*

Join us for BIOMAN 2015 on July 13 through 16 at Ivy Tech Community College in Bloomington, Indiana. For information on registration or professional development sponsorships, visit <http://biomanufacturing.org/content/bioman-2015-conference>

Three-Day Workshops Provide BIOMAN Participants with Hands-On Laboratory Experiences

Biofuels Production and Analysis with Microalgae

The Intermediate Track workshop, Algal Oil to Biodiesel, provided participants with an overview of commercial algal oil production and subsequent conversion of the oil into biodiesel.

The day before BIOMAN started, a 500 mL GroFizz photobioreactor with 450 mL of sterile growth media was inoculated with 50 mL of a concentrated *Chlorella* microalgae culture prepared by NBC2 partner, Rhykka Connelly of GroFizz.



Greg Poruban, biology and biotechnology teacher at Hatboro-Horsham High School in Horsham, Pennsylvania, works in a chemical fume hood as he adds reagents to convert the extracted algal oil to biodiesel.

By Monday afternoon when the intermediate track workshop began, the microalgae concentration had doubled. At this point, the four-person groups of BIOMAN participants took baseline measures of samples for lipid concentration, pH levels, chlorophyll concentration, and dry cell weight. They also examined the *Chlorella* sample and checked for predators and competitors using a projector microscope.

On Tuesday, participants continued to track the growth of microalgae, and began the process of extracting and analyzing lipids from algae samples to produce biodiesel.

On Thursday, participants continued to monitor the growth of *Chlorella* in the photobioreactor. They also finished the process of converting the extracted lipids into biodiesel by chemical transesterification of the lipids and determined the conversion rate. Participants also followed a quality control chemistry standard operating procedure that utilized thin layer chromatography (TLC) to compare the lipid components of both the algal oil and biodiesel produced from the algal oil.

The Microalgae-Oil-Biodiesel Core Production System curriculum, along with GroFizz photobioreactors and TLC quality control biochemistry kits, will be available from NBC2's e-store in 2015.



*Deborah Davis, biotechnology coordinator at Bluegrass Community and Technical College in Lexington, Kentucky, (left) looks on as Sarah Hill, chair of the Biology Department at Stark State College in North Canton, Ohio, vortexes a sample of the *Chlorella* microalgae culture.*

Educators Amplify Bacteria Genes and Measure Protein Activity

The Beginner Track workshop, Cellulase Cloning and Expression, focused on amplification of a cellulase gene from *Bacillus halodurans*, its transfer to *Escherichia coli* bacteria cells, and measurement of the activity of the purified enzyme.

As science educators, BIOMAN participants had a basic understanding of how cellulose in various plants can be enzymatically converted into simple sugars. With traditional fermentation methods these sugars can then be used in a variety of industrial biotechnology applications.



Linda Rehfuß, associate professor of biology at Bucks County Community College, Newtown, Pennsylvania, (left) and Sheila Byrne, NBC2 grant assistant at Montgomery County Community College in Blue Bell, Pennsylvania, pipette PCR reagents.

During the three afternoons of the beginner track workshop, Craig Caldwell, chair of the Biotechnology Department at Salt Lake Community College and interim dean of the School of Science, Mathematics and Engineering, guided BIOMAN participants' use of the tools and processes commonly encountered in biotechnology research, development, and biomanufacturing.



Chloe Cigarroa, STUDENTfactureED® product manager at Salt Lake Community College in Salt Lake City, Utah, uses a mini-centrifuge to separate a sample.

Participants utilized the polymerase chain reaction (PCR) to amplify a cellulase gene from the genome of *B. halodurans*, a hardy soil organism that breaks down cellulose from plant matter. Next they inserted the gene into a DNA plasmid that was then delivered to *E. coli* cells for the production of the enzyme. During the final workshop session, participants used a series of analytical methods to assess the purity of the enzyme and its activity.

Workshop Teaches Complex Transfection Skills

The CHO Cell Transfection Workshop, the advanced track option at BIOMAN 2014, gave 12 educators the opportunity to complete a sophisticated biotechnology process and learn how to incorporate the module for it into their programs.

The lab exercises were led by NBC2 co-PIs Bill Woodruff, head of the Biotechnology Department at Alamance Community College in Graham, North Carolina, and Maggie Bryans, assistant professor of biotechnology at Montgomery County Community College in Blue Bell, Pennsylvania.

During the three afternoon sessions, workshop participants cultured, transfected, and analyzed CHO-K1 cells, the mammalian cell type most often used in biopharmaceutical biomanufacturing. Transfection is the process for introducing a gene of interest into cells; the gene is expressed and the protein of interest produced.

By transfecting the CHO-K1 cells with pAcGFP1-Actin, a plasmid vector containing the gene for green fluorescent protein conjoined to actin, and pDsRed2-Mito, a plasmid vector for red fluorescent protein conjoined to a peptide with an affinity for mitochondria, participants tagged the cellular cytoskeleton and mitochondria with the fluorescent proteins.

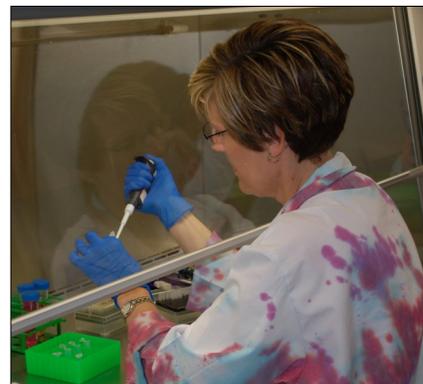
A blue fluorescent DAPI nuclear stain was used to visualize the nuclear DNA. This made it possible to view the cells using a fluorescent microscope. With a projector attached to the microscope, workshop participants observed the results of their hands-on work which colored the cellular actin cytoskeleton green, the mitochondria red, and the cell nuclei blue. They then compared results using filters that displayed the cells separately in green, red, and blue, and in a three-color overlay.



Bill Woodruff, head of the Biotechnology Department at Alamance Community College in Graham, North Carolina, addresses BIOMAN workshop participants in front of the enlarged image of the transfected CHO-K1 cells viewed with a fluorescent microscope.



Guadalupe Tapia, a biotechnology teacher at Silva Health Magnet High School in El Paso, Texas, dispenses CHO-K1 cells into a 24-well plate while Lori Dodson, a biotechnology instructor at North Montco Technical Career Center in Lansdale, Pennsylvania, observes.



Lara Dowland, chair of the Biotechnology and Biomanufacturing Department at Mount Wachusett Community College in Devens, Massachusetts, prepares the plasmid vectors for transfection into the CHO-K1 cells.

BIOMAN Interactions Shape New Biotech Program



Biology Instructor Barbara Juncosa gathered information at BIOMAN to launch a new biotechnology program at Citrus College. The program will prepare technicians for careers at companies near Glendora, California, that are involved with drug product manufacturing, also known as aseptic formulation, fill, and finish.

"It's been fantastic. I've been able to talk to veteran instructors about the outline of their programs, what the different courses are that they've included, pre-reqs that they have on their programs. And then, in terms of the individual courses: What do they cover in the courses? What textbooks are they using? Lab activities? So it's been really a gold mine of information for me, so I don't have to reinvent the wheel," she said.

Based on what she learned at BIOMAN, Juncosa was reconsidering which courses to include in the new certificate's curriculum and how the courses would be scheduled.

"BIOMAN is like painting with the masters."

*Janet Butler, Biomanufacturing Technology Teacher
Davies Career & Technical High School, Lincoln, Rhode Island*

QC Microbiology Workshop Offers Experience with Industrial Quality Control

The Quality Control Microbiology Workshop exemplified the breadth of material NBC2 covers during BIOMAN's hands-on workshops.

During the very active three-hour session, four NBC2 staffers led small groups of participants through hands-on lessons utilizing *Limulus Amebocyte Lysate* (LAL) assays, Gram stains, and API assays. Participants also learned how to use air samplers and particle counters that are used to determine air quality in biopharmaceutical biomanufacturing facilities.



Maggie Bryans, assistant professor of biotechnology at Montgomery County Community College in Blue Bell, Pennsylvania, (center) shows Janet Butler, biomanufacturing technology teacher at Davies Career and Technical High School in Lincoln, Rhode Island, (left) and Greg Poruban, biology and biotechnology teacher at Hatboro-Horsham High School in Horsham, Pennsylvania, (right) how to perform the Limulus Amebocyte Lysate (LAL) gel clot assay to determine endotoxin levels in a cell culture sample.



Tim Kull, biotechnology technician at Montgomery County Community College in Blue Bell, Pennsylvania, assists Amy Coy, grant project manager and academic advisor at Ivy Tech Community College in Bloomington, Indiana, as she utilizes a Gram staining standard operating procedure to identify Gram-negative and Gram-positive bacteria.



Linda Rehfuss, associate professor of biology at Bucks County Community College, Newtown, Pennsylvania, uses a laser particle counter in order to determine the number of particles in the HEPA-filtered air of a biological safety cabinet.

Interactive Session Explains NBC2 Curriculum

The Teaching Biomanufacturing with NBC2 Curriculum session provided an overview of NBC2's suite of curricular materials including a textbook, lab manuals, online modules, and other resources that have been developed with significant industry input and NSF support.

"We're trying to make it as industry relevant as possible. This is what they [students] are going to see if they go into a production facility," Maggie Bryans said, referring to the biomanufacturing topics covered in NBC2's *Introduction to Biomanufacturing* textbook. Bryans is an assistant professor of biotechnology at Montgomery County Community College in Blue Bell, Pennsylvania and a co-principle investigator of NBC2.

The textbook comes with online access to PowerPoint slides, videos, and links to other resources, including online modules that give students the opportunity to use virtual biomanufacturing equipment.

NBC2's curriculum covers the engineering of biomanufacturing facilities; metrology; validation; environmental, health, and safety; operational excellence; quality assurance; microbiological control; quality control biochemistry; upstream and downstream processing; and process development.

"Based on where you are and what topics you like to teach, you can customize the textbook to reflect the chapters, or you can use the whole book because it gives students a good overview," said Linda Rehfuss, associate professor of biology at Bucks County Community College in Newtown, Pennsylvania. She is also an NBC2 co-principal investigator.

During the interactive session at BIOMAN, Bryans and Rehfuss shared biomanufacturing course syllabi and schedules, and offered tips to high school and college educators who asked questions about equipment and curriculum, and sought advice for teaching particular aspects of biomanufacturing.

"We're happy to share anything," Bryans said.



NBC2's Introduction to Biomanufacturing textbook is the cornerstone of the NBC2 curriculum. For information on how to purchase a copy, visit www.biomanufacturing.org/curriculum.

Grants to Small Businesses Fund Research by Educators and Students

Funds for educators and students to gain first-hand experience in the research aspects of product development are available from the Small Business Innovation Research (SBIR) grant program offered by the National Science Foundation (NSF).

Companies that have been awarded SBIR Phase II grants by NSF can apply for supplemental funds to partner with community colleges or to provide internships for undergraduates and educators to assist with research that helps bring new products to market. A separate program provides up to \$10,000 per U.S. military veteran who is enrolled in college and engages in research for the product covered by the SBIR grant.

"It's a good deal," said Sandra Porter, a co-principal investigator of Bio-Link, and president of a small company. She learned about the potential for SBIR funding to support faculty professional development and undergraduate research internships only recently when her company—Digital World Biology—received an SBIR Phase I grant from NSF.

"You can engage in professional development, benefit a company, make better contacts, build bridges for your students, and get paid," Porter told BIOMAN participants of the benefits they could receive from working short-term stints as technicians at companies with SBIR grants.

For more information follow the "Institutional Partnerships" and "Educational Partnerships" links at <http://www.nsf.gov/eng/iip/sbir/Supplement/index.jsp>

Advice for NSF Grant Seekers

"Do your homework," V. Celeste Carter advised the educators at BIOMAN after explaining various National Science Foundation (NSF) funding opportunities during a teleconference call to BIOMAN. Carter is the co-lead of the NSF's Advanced Technological Education (ATE) Program.

Whether a faculty member is working with a company that has received SBIR funding, writing an ATE grant proposal, or applying for another grant, Carter said those seeking NSF support should address five questions: "Why is the work important? What has already been done? What are you going to address? Do you have the team to carry out the project? How will you assess the outcomes and tell others about them?"

BIOMAN Informs Lab Plans and Teaching Strategies

At BIOMAN 2014, biotech teacher Liz Taylor got many ideas for redesigning the laboratories at Dover High School and Career Tech Academy in Dover, New Hampshire, and refining instructional lab activities.

She signed up for her first BIOMAN specifically to see the labs at Salt Lake Community College (SLCC) because the high school where she teaches has money to upgrade its labs. She plans to share what she observed in the four different labs at SLCC with the school's architect.



In the short term, the tenth and twelfth graders in her biotech and Advanced Placement biology courses will benefit from the lab activities she learned during the workshops.

"This is like a loaded bullet. This is great," she said of BIOMAN.

"Another cool aspect of this is [that] I'm running a dual-credit course, so this helps me see the other side of that; what community college teachers are doing and expecting of their students. So this really helps me see how I can better align my program," Taylor said. The dual-credit course is with Great Bay Community College in Portsmouth, New Hampshire.

Liz Taylor
Biotech Teacher
Dover High School and
Career Tech Academy
Dover, New Hampshire

To identify companies with SBIR-II grants, Sandra Porter suggests the following steps:

1. Start with the **Advanced Search** option on the NSF website <http://nsf.gov/awardsearch/advancedSearch.jsp>
2. In the **Keyword** field type: "**SBIR phase II**" (Be sure to use quotation marks.)
3. In the **Expiration Date** menu select **Find dates on or after**, and in the **From** field enter a date six months after the current date.
4. Hit **Search**.
5. Select **Show More** on the left-hand menu options to see active awards in every state or choose just one state.
6. Click on **Award Titles** to read grant abstracts.
7. Choose the **Excel** export option on the **Awards List** to obtain the contact information for the companies with SBIR grants.
8. Contact the principal investigators of relevant projects by email or phone to introduce your program and ask whether the company would be willing to apply for supplemental funds to cover the personnel costs for faculty and / or students to do research at the company or at the community college.

Biotech Instructor Encourages Participation In Bioscience Industrial Fellowship Program

Scott Gevaert shared his experiences at the June 2014 Bioscience Industrial Fellowship Program during a BIOMAN luncheon presentation.

The National Center for the Biotechnology Workforce based at Forsyth Technical Community College offers the four-week fellowship program—with formal instruction at three community colleges and tours at numerous biotech companies and academic labs—to community college instructors with support from a National Science Foundation Advanced Technological Education (NSF-ATE) grant.

Gevaert, the program coordinator of the Life Science Lab Assistant program at St. Louis Community College in St. Louis, Missouri, came away from the fellowship ready to implement clever ways of teaching aseptic techniques, lab notebook accuracy, standard operating procedures, and other industry-relevant skills. The modules developed by the fellows will be posted at <http://biotechworkforce.org>.

A key message Gevaert plans to share with students came from Biogen Idec employees who make hiring decisions:

"There are certain jobs where you have to have a bachelor's or higher degree. But there are a lot more jobs where you can have a certificate or associate and work for the company. Regardless [of academic credential], what they want are the soft skills. Can you communicate? Can you write effectively? Can you orally communicate? Do you have good attention to detail? Are you reliable?"

Of all the "cool industry visits," Gevaert's favorite was the Regenerative Medicine Institute at Wake Forest University in Winston-Salem, North Carolina. There the educators learned about clinical trials that utilize cells from patients to grow replacement skin, cartilage, tubal systems, and hollow organs to replace those damaged by disease or injury. They observed various stages of the research that grows cells on scaffolds and prepares them for implantation in patients.

The 2015 NSF-ATE Bioscience Industry Fellowship program will be held from June 1 to 26 at the National Center for the Biotechnology Workforce in Winston-Salem, North Carolina. To apply, contact Russ Read at rread@forsythtech.edu or Mica Welsh at mwelsh@forsythtech.edu.

Niche Companies Offer Opportunities for Biotechnicians

Peter Knauer, chief operating officer of BioUtah, urges educators to prepare technicians for careers at small, niche life science companies that have taken on the tasks shed by large "brick and mortar" companies.

Knauer is the vice president of chemistry, manufacturing and control at two "virtual" companies: Symic Biomedical and Jade Therapeutics, Inc. At BioUtah he serves as a liaison between the life science industry association, Utah's state government, and higher education.

The growth of virtual life science companies—small companies with just an office or no physical facilities—has evolved over the past 20 years in response to the high cost of drug development. Market pressures to maintain shareholder value as well as mergers have led many companies to economize by

outsourcing research, discovery, and testing to contract research organizations and independent labs. These niche companies now receive most of the Food and Drug Administration's approvals.

Because their staffs are relatively small, Knauer said, niche companies want to hire versatile biotechnicians who possess excellent laboratory skills, know how to keep detailed records, analyze data accurately, and stay on task.

Working for a niche company may have less job security than employment at an established life science company because taking a product from the lab to market can take up to 10 years and require investment of \$500 million or more.

"If you are willing to take that risk, it will be tremendously profitable for you in the long run," he said.

Speaker Provides Overview of Dietary Supplement Industry

As he summarized the tests used to characterize the active ingredients in *Cordyceps sinensis*, a fungus that grows out of certain caterpillars in China, Steven M. Wood gave BIOMAN participants an overview of the \$20 billion international market for dietary supplements and U.S. federal regulations of them.

Wood is director of Global Research at Pharmanex, a nutritional supplement company. Pharmanex is part of Nu Skin Enterprises, Inc., which is based in Provo, Utah, and does business in 53 countries. The dietary supplement industry is one of the leading sources of income in Utah.

Some of Pharmanex's analysis of *Cordyceps sinensis* has been

performed by students who earn academic credits for internships with InnovaBio®, the non-profit contract research organization (CRO) run by Salt Lake Community College's biotechnology department.

Wood finds the fresh perspective of students working under the guidance of faculty in an independent facility helpful. "They may not be entrenched in a specific process or a specific way of approaching it. This has been great," he said, noting that the company has contracted with InnovaBio® on several projects. He thinks the CRO benefits students, too, by giving them experience working on real product development questions.

Biomanufacturing Innovations Wow BIOMAN Participants

Ronald C. Sims impressed BIOMAN participants with his description of the Sustainable Waste-to-Bioproducts Engineering Center's (SWBEC) piloting of processes to develop protective gear from spider silk and biofuel from wastewater algae.

Sims, head of the Biological Engineering Department and co-director of the SWBEC at Utah State University in Logan, Utah, emphasized during his keynote Thursday, July 17, that the multifaceted research efforts are intended to strengthen industry, help human health, and improve the environment by developing less expensive and less toxic alternatives to current products.

"The goal is to make this thing work from an economic point of view, to make a lot of products," he said.

Sims' talk focused on the center's efforts in scaling production of biomanufactured spider silk, algae from municipal wastewater, and biomass from various sources. Sims said the university wants to demonstrate the products' potential and then hand them off to companies for commercial production.

To produce incredibly strong, versatile silk the researchers have taken genes from golden orb web spiders and put them

into a variety of organisms. From these tests, they have found that placing the plasmid of the silk DNA into *Escherichia coli* bacteria produces silk quickly and inexpensively. Because it is biodegradable and biocompatible, the silk has potential medical uses to repair tendons and to stitch wounds. Given its strength and flexibility, the silk could also be used for protective gear, seat belts, and bridge cables.

Efforts to develop bioproducts from municipal wastewater lagoons currently focus on multiple uses of algae. The Rotating Algae Biofilm Reactor, which the center's researchers developed, uses wastewater to feed the algae that are grown on the film as it moves through the reactor. Low-tech methods of using brushes and vacuums, currently operated by students, scrape off the algae. With additional processing, Sims says, the wet algae or proteins derived from it can be used for biodiesel, bioplastics, animal feed, and antioxidants as well as the commodity chemicals acetone, butanol, and ethanol.

After his presentation, Sims spent the day at BIOMAN observing the workshops, talking to participants, learning about biomanufacturing programs at community colleges, and discussing possible collaborations.

Teacher's Persistence Gets Students into Job Shadowing Experiences

For the past two school years Janet Butler has attained 100% placement of her biomanufacturing seniors in job shadowing experiences.

Nineteen seniors from Davies Career and Technical High School in Lincoln, Rhode Island, will have nine full days during the fall 2014 semester and nine full days during the spring 2015 semester to work alongside mentors in the laboratories of either a hospital, department of health, sewage authority, or commercial life science testing facility.



"It's very difficult to get kids placed," Butler said, explaining that no biophar-

*Janet Butler
Biomanufacturing Technology Teacher
Davies Career & Technical High School
Lincoln, Rhode Island*

maceutical companies near the career tech high school will take students due to regulations that prohibit 17- and 18-year-olds from interning or job-shadowing at their facilities.

However, by meeting repeatedly with key people at the hospital, municipal agencies, and commercial lab, Butler was able to explain how the laboratory, analytical, and bioinformatic skills taught in the high school biomanufacturing program fit with their needs for lab technicians and quality control personnel. In her conversations with employers, Butler emphasized that the students who enroll in the four-year biomanufacturing program have the skills and maturity to work with mentors in their facilities.

"You have to beat the door until you get the door down. And once you get in one place, and you send your good kids—kids you know you can count on—word gets around," Butler said. The glowing reviews earned by the 2013-14 seniors smoothed the way for the current student cohort.

BIOMAN Tours Utah Bioscience Companies

Each BIOMAN conference includes tours of biomanufacturing facilities near the host college. The 2014 tours offered insights into the challenges and rewards of manufacturing biotechnology products for U.S. and international markets.

At the headquarters of USANA Health Sciences, Inc., in Salt Lake City, BIOMAN participants met with company leaders and toured the facility where dietary supplements and personal care products with micronutrients are produced for distribution in 18 countries. During the question-and-answer session, the educators learned about the skills that USANA

leaders look for when they hire biotechnicians for laboratory, production, and quality control teams.

BIOMAN participants also toured the medical device manufacturing facility that Edwards Lifesciences Corporation opened in Draper, Utah, in 2010. Edwards Lifesciences produces heart valves and hemodynamic monitoring systems that physicians around the world use to care for patients. During their visit, the educators learned about the tasks and expectations for employees in regulated work environments.

Effective High School Outreach Takes Various Forms

The three high school outreach programs showcased at BIOMAN take different approaches to the challenge of recruiting students for biomanufacturing technician careers. One initiative prepares high school teachers and community college faculty to teach biomanufacturing; another builds collaborations with industry partners that provide laboratory equipment and experiments to schools; and another focuses on concurrent enrollment and faculty professional development.

NBC2's Protein Is Ca\$h Workshops Builds Teachers' Skills

NBC2 has offered Protein Is Ca\$h workshops every summer since 2010 for high school teachers in locations around the nation. These workshops have created a network of educators with the skills to add biotechnology and biomanufacturing to their high school courses and, importantly, introduce these career paths to their students.

Maggie Bryans explained that during the five-day Protein is Ca\$h workshops teachers learn about and follow standard operating procedures that teach them about biomanufacturing processes. They learn about transformation of *Escherichia coli* bacteria cells to synthesize particular proteins, protein purification, anion exchange and other types of chromatography, quality control biochemistry, and biofuels production. Bryans is a co-principal investigator of NBC2 and assistant professor of biotechnology at Montgomery County Community College.

MiraCosta College Combines Several Industry Initiatives

The biotechnology program at MiraCosta College combines financial contributions from the Sigma-Aldrich Global Citizenship program with equipment from Amgen's Biotechnology Experience program and the Salk Institute's Mobile Science Laboratory. The resulting biotech instructional kits are distributed to San Diego County teachers who attend Life Science Summer Institutes at their partner college, Miramar College in San Diego, California.

"The value I see is building new connections with some of these

teachers at the middle schools and high schools," said Mike Fino. He is the chair of MiraCosta's Biotechnology Department and a co-principal investigator of NBC2. In the future MiraCosta biotech students will earn service learning credit for cleaning and servicing the "turn-key kits" so they can be reused.

Salt Lake Community College Offers

Concurrent Enrollment and Professional Development

Hundreds of students at 18 high schools in the most populated regions of Utah have earned college credits for the biotech courses they have taken at their schools thanks to the concurrent enrollment partnership of Salt Lake Community College (SLCC) and Utah Valley University, explained Craig Caldwell, chair of SLCC's Biotechnology Department and interim dean of SLCC's School of Science, Mathematics and Engineering .

In addition, SLCC offers a Summer Science Institute for educators that covers genomic sequencing, the polymerase chain reaction, gene expression, and analysis of protein functions. With the support of a National Science Foundation STEM Talent Expansion Program grant, the five-day workshop is open at no cost to all Utah high school science teachers.

Outreach has Broad Goals

All the BIOMAN panelists view their outreach efforts as important for improving science literacy and raising awareness of STEM careers, rather than as quick methods to boost enrollment in their community college biotech programs.

To increase the odds of recruiting students for community college biotech programs, the panelists:

- Align programs with high schools' schedules and state education standards; and
- Focus on students in college prep science courses because they are more likely to enroll in two-year colleges, rather than honors and Advanced Placement students who have already decided to attend four-year colleges.

BIOMAN Boosts Knowledge of High School Teacher

Guadalupe Tapia is a pioneer for biotech education in El Paso, Texas, where she teaches forensics and biotechnology at Silva Health Magnet High School. It is the only high school among seven South Texas school districts that offers biotechnology. She has 48 students in two classes.

yesterday I did the electrophoresis with Mary Jane [Kurtz] because I have been doing the horizontal electrophoreses but still I was not feeling confident on doing the vertical. Because these are smaller classes you have more interaction with the teacher," she said. Kurtz is a retired high school teacher and former NBC2 co-principle investigator.



Tapia learned about the use of microalgae for biofuels at BIOMAN 2013 and expanded her knowledge of cell culture techniques at BIOMAN 2014.

"Those are the things I was not familiar with, so I'm getting more confidence or at least know how to work with [them]. Like

Guadalupe Tapia
Biotechnology Teacher
Silva Health Magnet High School
El Paso, Texas

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